DOCUMENT RESUME

ED 242 121 EC 161 891

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TITLE Microcomputer Software in Special Education: Selection and Management. Information Product Number Two. Report to RRC's. Microcomputer in the Schools--Implementation in Special Education.
INSTITUTION COSMOS Corp., Washington, DC.; SRA Technologies, Inc., Arlington, VA.
SPONS AGENCY Special Education Programs (ED/OSERS), Washington, DC. Div. of Educational Services.
PUB DATE [Nov 83]
CONTRACT 300-82-0250
NOTE 25p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Administration; Case Studies; *Computer Assisted Instruction; *Computer Managed Instruction; *Computer Software; *Disabilities; Elementary Secondary Education; *Microcomputers; Special Education; Teacher Attitudes

ABSTRACT

The report describes a project assessing the organizational issues surrounding microcomputers in special education, with special emphasis on software selection and use. Twelve districts were visited, and both administrative and instructional applications of microcomputers were observed. Two major types of software--applications and systems software--are described, and the principle applications of microcomputers in special education instruction (computer assisted instruction, computer managed instruction, computer literacy, and computer science) and administration (word processing, financial, statistical, and graphic systems, and file management systems) are reviewed. A discussion on selecting and acquiring software addresses difficulties facing many districts in identifying appropriate software and in increasing teachers' knowledge about educational software. Evaluation criteria for special education software is suggested, including flexibility, and availability and distribution of educational software. A final note emphasizes the need to adopt more appropriate CAI software for special education and to develop more authoring and computer managed instructional systems. (CL)

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MICROCOMPUTERS IN THE SCHOOLS-- IMPLEMENTATION IN SPECIAL EDUCATION

Information Product Number Two
Report to RRC's

Microcomputer Software in Special Education:

Selection and Management

Tom V. Hanley

SRA Technologies
and
COSMOS Corporation

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This research is sponsored by the U.S. Department of Education, Special Education Programs, Division of Educational Services, Contract Number 300-82-0250. The two-year (1982-1984) project is being conducted by SRA Technologies, Inc. of Arlington, Virginia, and COSMOS Corporation of Washington, D.C. The opinions expressed in this document are those of the authors and do not necessarily reflect the position or policy of the U.S. Department of Education, and no official endorsement should be inferred.

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MICROCOMPUTER SOFTWARE IN SPECIAL EDUCATION: SELECTION AND MANAGEMENT

Introduction

Microcomputers came along at just the right time; they can be used effectively to meet a variety of the needs of handicapped children, and they will prepare students for meaningful and rewarding jobs in the future.

or . . .

The microcomputer craze is a boondoggle; special education administrators and teachers are jumping on this bandwagon without knowing where it's going.

Which of these statements is correct? Is either false, or is there an element of truth in both? Some people feel that microcomputers are the best thing to reach the schools since chalk. Others are not so sure. And some believe that the microcomputer invasion will one day be viewed as another questionable experiment that wound up getting stored in the closet with the overhead projector.

As educational researchers, we try to take a more neutral position. We (SRA Technologies of Arlington, Virginia, and COSMOS Corporation of Washington, D.C.) are conducting a study for the U.S. Department of Education, Special Education Programs. The study is entitled "Microcomputers in the Schools--Implementation in Special Education."

During the past spring, we conducted case studies in 12 school districts around the country where microcomputers were being used to support services provided to handicapped students. The focus of our research was on organizational issues: the ways microcomputers were introduced, the people managing them, collaboration between special and regular educators in the use of the equipment, training for teachers, and roles that emerged to foster and support the microcomputer applications.

Based on this research, and on other information we have collected during the past year, we are now developing reports to share our findings with other educators who are interested in this issue. This report deals with software selection and use. This is an area we found to be of major interest to RRC and State Directors, through our participation in some of their meetings this summer. This report describes the software-related activities we documented in the case studies and, based upon what we observed in the school districts, offers some recommendations for good practices. The report also includes references to software resources that seem to be particularly useful for special educators.

Regarding the current debate about the validity of microcomputers in special education, our position is that the issue is much too complex to draw simple conclusions. Very little that occurs in special education is simple, and microcomputers are no exception. An example of the complexity of this issue is the diversity of applications that are being tried. Across the 12 districts that we visited, microcomputer-based applications were being attempted in the following areas:

Administrative --

- Accounting/budgeting
- Attendance/enrollment
- Bibliographic records (library)
- Class scheduling
- IEP development/monitoring
- Inventory
- Personnel records
- Student grades
- Student records
- Test scores
- Transportation scheduling
- Word processing/mailing lists

Instructional applications--

- Career counseling/guidance
- Communication aides
- Computer-assisted drafting (CAD)
- Computer-assisted instruction (CAI)
- Computer-assisted music composition
- Computer literacy
- Computer-managed instruction (CMI)
- Computer science/programming
- Vocational education
- Word processing

Given this variety, it is important to distinguish practices and effects within different applications. Fortunately, there are also some general procedures and objectives for software selection and use that have common strengths and weaknesses across a number of situations. Nevertheless, distinctions will be drawn in areas where different approaches can serve different ends. To begin . . .

What is software?

Software is computer programs--the lists of instructions that tell the computer what to do. There are two major types of software: (1) applications software and (2) systems software. Applications software includes all those programs that allow the user to simulate real-life

functions: to play a game, balance a financial statement, engage in tutorial instruction, etc. Systems software, in contrast, includes the less visible (often hard-wired) programs that actually operate the computer; operating systems (such as CP/M and TRS-DOS) and computer languages (such as BASIC) are prime examples of systems software.

Who uses these different types of software?

In special education, users will be most interested in applications software. This is especially true for the selection and adoption of additional software, after the microcomputers have already been acquired. Most microcomputers come equipped with an operating system. The typical teacher will initially use the operating system only for a few functions: loading and running programs, saving and copying programs. Once these functions have been mastered, they become almost automatic for the user. New software is purchased to be "compatible" with the standard operating system. Only a few "enthusiasts" in the schools get more involved in learning and using special features of the operating system. Similarly, only a few teachers will, unless required to so do, learn programming languages.

This distinction among users is very important. There is a broad range of interest in microcomputers represented by users in the schools. At one extreme are the intial adopters -- the enthusiasts or experimenters. Such individuals are often involved in the initial introduction of microcomputers in the school(s). They are highly motivated to use this technology and are often self-taught. They are also willing to accept extra responsibilities related to microcomputer implementation and to "make the software work," especially when resources are limited and the available software has been inefficiently designed.

The more general users include both those who have seen the success of the initial adopters and want to use this new "tool" with their students, and those who have been provided with a microcomputer by school administration and are now being encouraged to use the technology. The growth of microcomputer applications in a special education program depends on the success of this second group--they represent the majority of users in a system-wide adoption of microcomputers.

These users are not generally interested (at least at first) in the microcomputer itself; they are more interested in what it can do to assist them in providing instruction. Their attitude toward the microcomputer is about the same as their attitude toward a tape-recorder or a video-disc player: it is just another educational tool.

At worst, their perception of the technology may include some "cyberphobia;" they may actually fear the microcomputer, either because of concern regarding its impact on their program, or due to a sense of inadequacy regarding their ability to master the technology. In any case, these users and potential users may not be quite as willing (as the enthusiasts) to put in a lot of extra effort to use the microcomputer. They want a true

"stand-alone" device--one that works easily and does exactly what they want it to do. They want educational software that runs itself.

What are the principal applications of microcomputers in special education?

As already mentioned, a broad variety of microcomputer applications are currently being attempted in the schools. Nevertheless, most of these can be generally grouped into two major categories: administrative or instructional. One advantage of this distinction is that it represents, in most cases, a clean separation between two different groups of users (administrators and teachers) and two different sets of software products--administrative and instructional software products are generally distinct. There are, however, some "cross-over" products:

- Word processing (WP) software is often used by administrators to support clerical and communication tasks. In a few districts that were studied, however, WP software was also used by business and vocational education teachers. WP software was also used by English and journalism teachers to improve students' composition skills. And most interestingly, WP software was used in special education classrooms and resource rooms to improve reading and writing skills and to foster eye-hand motor coordination. Bank Street Writer, a relatively simple and easy-to-learn WP program, seemed highly adaptable to the special education approach.

- In one school district, high school students (including special education students) participated directly in the microcomputer-based administrative applications. Students entered data and updated files in the school's data base management system. This occurred as part of the vocational/career center program. The director of the program, a former special education teacher, felt that this experience provided good training for future job opportunities.

- In another district, students in the special education home economics program used inventory and cash-accounting software to manage finances and supplies for the student-run luncheonette. The teacher had also programmed one microcomputer to simulate a cash-register. This experience was viewed as building skills that would be transferable to subsequent employment possibilities, such as in fast-food restaurants.

In general, however, special education applications of microcomputer software for administrative or instructional applications were clearly separated. Administrators used microcomputers to support record-keeping and clerical tasks. Teachers used microcomputers to assist them in providing direct instructional services to their students.

What software is used for special education administrative applications?

As anticipated, many school districts used microcomputers to support some of the management tasks associated with P.L. 94-142. The most common application was use of microcomputer-based, information management systems to record and maintain "child counts" and student records for handicapped children. Some districts also used "spread-sheet" or inventory programs to maintain finance and equipment records. Management software was also used to schedule educational and transportation services (e.g., school buses).

In general, there are three broad types of applications software that are commercially available and useful to administrators:

- word processing systems;
- financial, statistical, and graphic systems; and
- file management systems.

Within each of these categories, a wide variety of specific software products is available. Until recently, most of the software products were designed specifically for a particular hardware configuration (brand and model of microcomputer) or for a specific operating system (such as CP/M). This linkage -- between particular hardware and software products -- was evident in many of the administrative applications observed in the school districts. Administrative applications customarily employed software that was developed by and marketed by the particular hardware manufacturers.

Nevertheless, it should be noted that this previous limitation to administrative software selection is disappearing. There is intense competition now between software development companies that produce programs for business and institutional (e.g., school administration) use. The more successful programs are being developed in a variety of formats, so that they will run on different microcomputers and operating systems. For future use, school administrators should recognize this fact and understand that they are not (generally) restricted in their selection of software by the specific hardware installed.

Additionally, some software firms have recently introduced "integrated systems." These are software packages that combine the features that were previously associated with separate software products: such as word processing and graphics and statistical applications, etc. In planning administrative systems, such integrated software solutions should also be explored.

During the case studies, many special education administrators also expressed interest in using microcomputers to assist in developing and monitoring Individualized Educational Programs (IEPs). However, only two (of the 12) districts had actually implemented microcomputer-based systems to do this. In both of these cases, the districts had developed their own software programs for the IEP applications. Further, the IEP software that these two districts had (independently) developed was being provided to and being implemented in other districts.

What software is being used for special education instructional applications?

Instructional applications of microcomputers fall into four broad categories:

- Computer-assisted instruction (CAI)
- Computer literacy
- Computer science
- Computer-managed instruction (CMI)

Although there is much debate in the literature about the meaning of these terms, for the purpose of our research they were defined as follows:

Computer-assisted instruction -- use of the computer to provide instruction in academic areas. The basic distinction between CAI and computer literacy or science is that the focus in CAI is on the academic area, not on the computer.

Computer literacy -- instruction in applications which emphasize using the computer to accomplish real-life tasks or using it for recreation. Computer literacy is generally intended to foster acceptance and some understanding of the workings of the computer itself. Many school districts have promulgated computer literacy curricula, with the intention of introducing and familiarizing all students to the computer. At a secondary level, computer literacy (by our definition) also includes business and vocational education applications of the computer: word processing, accounting, and other office automation skills. The software emphasized in computer literacy is applications software.

Computer science -- the instruction here is focused on the computer itself: to learn how to operate, program, and control the technology. Most computer science courses occur at the secondary level, and emphasize computer programming and systems operation and architecture. Systems software (operating systems and programming languages) is used and taught. The goal of this approach is often stated to be the preparation of students for careers directly linked to computers.

Computer-managed instruction -- the computer is used as a management tool to measure, plan, and monitor instruction. CMI applications can include testing, diagnosis, learning prescriptions, and student record-keeping. In the past, CMI systems installed on larger (mainframe and mini) computers often incorporated control over the presentation of CAI material. Based upon the student's prior performance, the computer would select the next step in the instructional sequence and move the student on to new lessons or practice exercises. This type of control has not yet been fully supported on microcomputers (some CAI software, nevertheless, does included limited CMI control-type functions). CMI is more typically

implemented on microcomputers as a separate applications program for testing and diagnosis. The results generated from CMI software are then used, by the teacher or diagnostician, to determine subsequent instructional steps, whether they be CAI or more traditional educational methods.

Recent surveys (e.g., H.J. Becker in School Uses of Microcomputers, Issue No. 1, April, 1983) have indicated that the most common instructional uses of microcomputers in the schools today are associated with the second and third types: computer literacy and computer science. This was generally true in the districts that participated in the case study research. However, it was not true in special education. There, the most common instructional usage of microcomputers was for CAI. In that context, a variety of applications and software were employed:

- The most common applications were educational games and "drill and-practice" exercises. Typically, the software used for these activities was purchased from external (to the school district) vendors and sources, both commercial and non-profit. The particular software programs in use were highly dependent upon the type of microcomputer installed. CAI software which ran on an Apple computer, for example, would not run on a Radio Shack, and vice versa. In a few districts, teachers, microcomputer coordinators, or consultants developed custom-made "drill-and-practice" software. This home-made software was typically programmed in BASIC. Commercial, non-profit (such as public domain), and home-made software all demonstrated a wide range of sophistication and reliability.

- In a few districts, more sophisticated CAI software, including tutorials and simulation programs, was used (minimally) in special education.

- Also in a few cases, computer-managed instruction (CMI) software was implemented, both in conjunction with CAI software and, alternatively, with paper, book, and pencil activities. Some of the CMI software was integrated with CAI software (such as the Milliken Math series); other CMI software was used independently to monitor student progress in academic areas and to assist development and identification of individualized goals and objectives for instruction.

In other districts, special education students were being exposed to computer literacy through introductory programming (such as LOGO) or word processing software. Two districts trained special education students to use WP software for reading, writing, and motor-coordination skill enhancement.

In the school districts that were studied, the instructional software used in special education was usually software produced and intended for regular education students. There were several reasons for this:

- In many of the school districts, there was extensive collaboration between regular and special education programs in the use of the microcomputers. Often the equipment was purchased with regular education (or general district or building) funds and the microcomputers were managed by regular education personnel. In these cases, the special education teachers often had to rely upon the equipment that was already available--the hardware and software that had been selected by regular education staff to provide instructional services to regular education students.

- As noted in many recent surveys and articles, most educational software produced by the private sector (commercial) has been targeted for the broadest market penetration--and that means regular education. Only a few software developers have shown any inclination to design products exclusively for narrow segments of the educational market, such as special education. Such products are only now beginning to appear and it will probably take some time for special educators to become more aware of them and to acquire them.

Even traditional special education materials producers, such as Developmental Learning Materials (DLM), have designed their instructional software to be used in both special and regular education settings. In most cases, however, the available CAI software lacks features that would be helpful in special education such as:

- ability to control pacing of instructions and lessons;

- subroutines for monitoring, recording, and reporting student progress;

- opportunity for the teacher to modify the level and nature of reinforcers supplied to the student; and

- options to change or add to the content of the materials being presented, or to tailor the lessons to the particular instructional needs of the student.

Selecting and Acquiring Software

Who identifies appropriate educational software?

In the case studies a variety of approaches to selection and adoption of instructional software were documented.[1/] Different approaches seemed to have different benefits and disadvantages.

The initial identification of appropriate software is a major problem in many districts, both in the districts we studied and, from all reports, in districts across the country. There are many reasons for this:

- This is a new technology for education; available software is going through a period of major change and growth. Many teachers and administrators who participated in the study remarked that the number and quality of available software programs have increased dramatically in the last few years. It has become increasingly difficult, even for those who are strongly motivated to do so, to keep up with all the listings and offerings of instructional software products.

- Many educators have been "burnt" with initial software purchases. Some CAI software, especially earlier products, were grossly inadequate to the (educational) tasks, or were mechanically unsound--many "bugs" and errors inhibited their use. In some of these cases, users became understandably reluctant to purchase new (untried) software and would, instead, keep using the few software programs they already had; ones they were familiar with and sure of, even if they were not particularly useful.

- Unless the school or district sets up special facilities (such as computer media centers/libraries) or special procedures (such as training, software notices, etc.) to make staff aware of software, most teachers are relatively isolated and limited in their knowledge of suitable software products. They tend to rely on information from a few other teachers in their school or, if they are luckier, on a microcomputer coordinator or enthusiast who can share information with them.

[1/] It should be noted that the current research was based on only 12 school districts and these were purposively (not randomly) selected. Consequently, the experiences of these districts cannot be generalized (especially in a statistical sense) to the experiences of other districts. In fact, the case study methodology treated each district as a separate experiment. Nevertheless, certain practices and their outcomes were very clear, even when they occurred in only a few situations. Under these circumstances, it is reasonable to draw a few conclusions.

This last point is very important. In all the districts that were visited, there was at least one and, more often, a few educators who were highly interested in microcomputer applications. Many of these individuals had evolved to become "coordinators" (formally or informally recognized by school administrators) for the microcomputer applications. To a large degree, these individuals represented the "knowledge base" for microcomputer implementation. Both administrators and teachers sought out their help and relied upon their judgment. The coordinators were also responsible for most of the training and technical assistance provided to new users.

In some districts, the coordinators were given an official role to screen teacher requests for software and to conduct initial reviews of software received by the district. They would also notify teachers of particular software products that might be useful to their students. The importance of these coordinators (and other enthusiasts) in initially identifying and subsequently sharing information about software with teachers cannot be overstated.

In a few districts, more formal procedures were established to make teachers aware of available software. In some cases this included centralized (district) or building level (school) libraries of educational software. Teachers (and, in some instances, students) were encouraged to visit these facilities, try out the software, and check it out or receive a copy (public domain software) to use in their classroom. Some districts also published bulletins or catalogs of the available software. These publications were distributed to teachers, who were encouraged to check these listings and request copies of the software for their classroom use.

An unusual practice, well received by both teachers and administrators, was observed in two districts. There, a component of the inservice training program on microcomputers was software review and evaluation. Each trainee was required to review and evaluate educational software products. Most of these were new products, software that the districts had recently acquired or review copies of software the districts were considering purchasing. This practice served two very useful functions:

1. It made the teachers more aware of the features that should be considered in selecting software for classroom use; and

2. It helped the districts identify appropriate software for larger purchases and distribution.

In contrast to these cases where some means were present for communicating and sharing information about software, there were other districts where computer-using teachers were relatively isolated from one another. In such instances, identification of new software was more difficult. An additional problem that also occurred in many schools was teachers' uncertainty regarding procedures for acquiring software, and their lack of awareness of funds that had been made available to allow teachers to purchase software.

What can be done to facilitate the identification of educational software?

Based upon the observation of these cases, it would seem wise for school districts (or program areas, such as special education) to take steps to increase teachers' knowledge about educational software.

- Centralized repositories of educational software (media centers, libraries) seem to be an effective mechanism. In small districts, one such center may be sufficient. In larger districts, it may be necessary to establish school-based or regional centers. These facilities should be easily accessible to staff during the school day. They should also include hardware equipment that allows the teacher to try out the software, and some technical person who is available to assist the teacher in making initial use of the software.

- Catalogs or newsletters/bulletins describing locally available software should be developed. This would be particularly important in districts where economic conditions might not permit establishment of software centers. It would also be valuable in districts that encompass large geographic areas, limiting teachers' access to centralized software repositories.

- If there are microcomputer coordinators or highly experienced and motivated users in the school or district, the knowledge base represented by these individuals should be tapped. Information about new software and their opinions regarding the existing software should be solicited and reviewed. Coordinators should also be assigned responsibility for screening teachers' requests for new software. In this capacity, they could provide useful guidance to the teachers and also prevent unnecessary duplication or inappropriate acquisition of software.

- Inservice training programs on the use of microcomputers should include exposure to the software that is already present in the schools. Teachers should also be presented with advice on the evaluation and selection of additional software.

How can special educators evaluate instructional software?

As already mentioned, there are certain features that special educators should look for in software programs. Most of these features come under the general heading of flexibility. Special education requires that each student be treated as an individual. This individualization should be carried over, as well, to the selection and use of CAI software. Unfortunately, many of the CAI programs that are readily available do not include features that would allow the teacher to tailor the lessons to the specific needs of each student.

There are a number of steps that local special education programs can pursue to foster appropriate, individualized use of educational software with handicapped students:

- Special education teachers need to be made aware of the features that are built into some software products and can be used to modify the presentation of lessons to students. This awareness can be provided through inservice training.

- In addition to awareness of special features, teachers should also be trained in using features that are present in the available software:

  -- how to modify or add to the substantive content of the lesson;

  -- how to control the presentation and pacing of lessons;

  -- how to monitor, record, and generate reports of student progress; and

  -- how to integrate CAI materials with the student's goals and objectives.

- Training of special educators should emphasize critical review and evaluation of software. It is, however, unrealistic to assume that most special education programs can or should develop a full-blown software evaluation system, particularly given the quantity of software that is available or being introduced. Fortunately, there are now a number of organizations that evaluate current and new software products. A few of these focus specifically on special education software, but most review the software for general educational suitability. Not suprisingly, many of the more general reviews also cover the features that are important in special education. (Regular education is now beginning to understand the importance of individualization.) Some of these resources are identified in Appendix A of this report. Included in the list are a number of publications which regularly carry excellent reviews of educational software.

- If possible, the special education program should develop a mechanism to provide for the regular review of materials from these resources and should assist teachers and special education administrators in identifying appropriate software. In addition, copies of software should be made available (e.g., library/media center) to all special education teachers who plan to use microcomputers. In this way, all staff may participate in identifying and selecting new software.

- Finally, some internal software evaluation system should be set up. As documented in two of the studied school districts, this could consist of making software evaluation a component of the district's (or special education program's) inservice training. Another useful approach would be follow-up evaluation, especially for recent software acquisitions. After a few teachers have had an opportunity to use the software in the classroom, their perceptions of its strengths and weaknesses could be surveyed. This follow-up

approach would be particularly useful as a precursor to any large-scale purchase or adoption of new software.

Where can you get new software?

Microcomputer software is available from a great variety of services. These include both commercial and non-profit (public domain) vendors. During the early years of microcomputer use, much educational software was acquired directly from hardware manufacturers or from mail-order suppliers. With the growth of local microcomputer stores, it is now possible to purchase and try-out software locally.

Most software development companies will also sell their software directly (through mail-order) to users. Alternatively, a number of educational software services have been set up which provide a selection of software products from various publishers. An added convenience with these multi-product vendors is that they will generally provide users with descriptive catalogs of the educational software. The catalogs list products, present brief descriptions and reviews (buyer beware!) of the software, categorize the software by subject or content area, provide grade or age ranges, and indicate the types of equipment (brands of microcomputers) on which the software will run.

There are hundreds of software suppliers who will sell "educational" software to the schools. A good reference source for special education is The SpecialWare Directory published by LINC Associates, Inc., 49 Arden Road, Columbus, Ohio 43214. Further, most school administrators are now regularly receiving (and perhaps being inundated with) unsolicited advertisements and catalogs from software vendors.

Insist on the right to review all educational software products before purchase. The great majority of reputable software suppliers have a review policy (usually 30 days) on their products. Take this opportunity and do not pay for any software until the product has been tested out in the classroom. It is a good idea to request only a review copy, or just one to two copies of the software. That will be enough to try the product out and will prevent the difficulty (and cost) of having to eventually return a large order.

Appendix B of this report is a short list of a few software suppliers (public domain and commercial) that offer a broad range of software and permit users to review the software before purchase. This list is not meant to be an endorsement, but only an initial listing of suppliers that were used, in different cases, by school districts in the study.

Naturally, software developers are a little reluctant in some cases to provide review copies -- for fear that users will copy them and return the original, unpaid. This is a legitimate concern and there have been cases

where users have made illegal copies of original material. (This is generally not a concern with public domain software.)

In response to this concern, some publishers have made arrangements, especially with larger school districts, to provide software at a discount if the school district signs a purchase contract that stipulates that illegal copies will not be made. If a special education program identifies particular software that would be useful in larger quantities (copies in each classroom or resource room), it would be a good idea to attempt to negotiate such an agreement with the supplier. This could lead to a cost savings and encourage the vendor to provide more review copies in the future.

How can educational software be managed and distributed?

Procedures for storing, sharing, and distributing educational software differed markedly across the school districts that were studied. In some instances, where the microcomputer use was highly decentralized and isolated to individual classrooms, teachers maintained their own software libraries. In these cases, teachers kept their software programs in plastic boxes or special binders designed for storage of cassettes or diskettes.

In schools where many teachers shared the software, different practices were evident. In some cases, a central library or repository of software was maintained. Teachers could check-out software for classroom use. In some schools a major portion of the microcomputer applications occurred in "computer labs." In these circumstances, the software was normally kept in one location in the lab and returned there at the end of the session.

Where software was shared among different classrooms or centers, an expected problem occurred: teachers and coordinators were not often sure who had the software and when it would be next available. In many cases, the microcomputer coordinators, and the teachers who interacted with them, relied upon personal "memory" to keep track of the software. This was a noble experiment but, especially with increasing use and proliferation of software, was doomed to failure. When more than two teachers will be sharing software, a formal "check-out/check-in" policy is called for. This will permit staff to access the software they need and, if it is currently in use, to know how soon it will be available. The system, therefore, should also include a date or time when the software will be returned.

An added benefit of a formal software management system is that it generates a paper (or microcomputer -- if automated) "trail" that allows coordinators and administrators to monitor use of the system and identify which software is most popular. This information can be very helpful for planning new software purchases or for making additional copies of the most popular public domain software.

Additional Comments

The preceding remarks covered some issues related to the selection and use of microcomputer software in special education. Most of the remarks concerned practices and their effects documented in the 12 school districts that were studied. There are, however, a few additional comments that should be made.

In the case studies, the CAI applications in special education were generally similar to CAI applications in regular education. Special education teachers received the same training and technical assistance as regular education teachers and they often shared the same software. It is true, of course, that the districts that were visited were not randomly selected; a few were purposively chosen because they demonstrated extensive collaboration between special and regular education. Nevertheless, the case studies indicated that many special education staff were adopting, with very few modifications, procedures and software designed for regular education use. Only in a few isolated instances was there evidence of special education using the technology in ways that were uniquely suitable to handicapped students. Consequently, we suggest that special education administration should take a more active role in planning and implementing the microcomputer applications, especially where special and regular education share the same equipment. One aspect of this would entail more involvement in the identification and acquisition of software that would be particularly useful for special education.

In addition to adoption of more appropriate CAI software, two other software products that need to be better tested and more actively encouraged in special education are authoring systems and computer-managed instruction (CMI) systems. Authoring systems permit teachers to design CAI software for specific lessons and instructions. Authoring systems would be particularly useful in cases where no readily-available commercial or public domain materials are present, and the individual needs of the child require a custom-made solution. A number of authoring systems, such as PILOT, GENIS, and Shell Games, are currently available and operate on microcomputers commonly implemented in the schools. One authoring system, BLOCKS (I and II), was developed specifically for special education use and includes extensive graphics subroutines that can increase student interest in the generated CAI software.

Similarly, CMI software offers potential promise for effective use in special education programs. It can be used to diagnose student performance and prescribe (or manage) subsequent learning activities. This could be very beneficial if integrated with individualized programs and plans (IEPs) for students. Unfortunately, little use of CMI software was evident in the studied districts and the programs that were used were, all too often, limited in their capabilities related to special education needs. This is an area of software development that special education should investigate more fully. Local special educators should identify and try out CMI software as it becomes more available.

Finally, the whole issue of microcomputer use in special education requires greater scrutiny. The professional literature is scattered with reports of "effective" use of this technology. However, it is difficult to generalize these isolated results to use in other schools and districts. As the current research documented, the approaches and the hardware and software used varied greatly from situation to situation. Under these conditions, it becomes even more important to develop local evaluation efforts. Previous remarks have suggested that local special education programs should become more involved in selecting and evaluating software. Special education programs can play a key role in monitoring and managing the applications. Ultimately, the processes developed to manage the software and hardware should evolve into procedures for determining the effectiveness of the technology. Only then will it be possible to actually measure the value of this technology in the education of handicapped students.

APPENDIX A

Resources for Information About Educational Software

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1. Special Publications:

Computers for the Handicapped in Special Education and Rehabilitation: A Resource Guide, and Learning Disabled Students and Computers: A Teacher's Guidebook. Both available from International Council for Computers in Education (ICCE), 135 Education, University of Oregon, Eugene, Oregon, 97403, (503) 686-4414.

Personal Computers for the Physically Disabled: A Resource Guide. Available from Apple Computer, Inc., M/S 9h, 10260 Bandley Drive, Cupertino, California, 95014, (408) 996-1010.

The SpecialWare Directory: A Guide to Software Sources for Special Education. Available from LINC Associates, Inc., 46 Arden Road, Columbus, Ohio, 43214.

Coburn, P., Kelman, P., Roberts, N., Snyder, T.F.F., Watt, D.H., and Weiner, C. Practical Guide to Computers in Education. Reading, Mass.: Addison-Wesley Publishing Co., 1982.

Goldenburg, E.P. Special Technology for Special Children: Computers to Serve Communication and Autonomy in the Education of Handicapped Children. Baltimore, Md.: University Park Press, 1979.

Taber, F.M. Microcomputers in Special Education. Reston, Va.: The Council for Exceptional Children (CEC), 1983

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2. Periodicals Which Review Educational Software.

Catalyst
Classroom Computer News
The Computing Teacher
Courseware Journal
Color Computing News
Creative Computing
Educational Technology
Electronic Education
Electronic Learning
Infoworld
Micro-Ed Digest
School Microcomputing Bulletin
School Microware Reviews
Teaching and Computers

2. Periodicals (continued):

TRS-80 Microcomputer News
Technological Horizons in Education (T.H.E.) Journal

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3. Special Education Networks:

DEAFNET. A project aimed at establishing telecommunications networks for the deaf. Contact: Teresa Middleton, SRI International, 333 Ravenwood Ave.., Menlo Park, California, 94025, (415) 859-2547.

EIES-The Electronic Information Exchange System. N.J. Institute of Technology, Newark, N.J., 07102. A national computer conferencing net work; hosts EIES/Handicapped.

HEX-The Handicapped Educational Exchange. A free national computer network for the exchange of ideas on the use of technology for the handicapped. Contact: Richard Barth, 11523 Charleton Drive, Silver Spring, Maryland 20902, (301) 681-7372.

SPECIALNET-Special Education Communications Network. A telecommunication and bulletin board system for special education issues. National Association of State Directors of Special Education, 1201 16th St., N.W., Suite 404-E, Washington, D.C., 20036, (202) 833-4218.

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4. Other Information Resources

U.S. Department of Education
Special Education Programs
Division of Educational Services
400 Maryland Ave., S.W.
Washington, D.C. 20202
They fund this project and other contracts and grants related to the use of new technologies in special education. Contact Jim Johnson or Jane Hauser, (202) 472-3394.

Association for Educational Data Systems (AEDS)
1201 Sixteenth Street, N.W.
Washington, D.C. 20036
AEDS is a non-profit association that focuses on computers and education. They publish the AEDS Journal, Monitor, and Newsletter and run conferences on educational computing.

The Council for Exceptional Children (CEC)
1920 Association Drive
Reston, Virginia 22091
(703) 620-3660

CEC has recently formed a special division on Technology and Media. Look forward to using this resource in 1984 for information on microcomputers in special education.

4. Other information Resources (continued):

EduTech
JWK International
7617 Little River Turnpike
Annandale, Virginia 22003
EduTech disseminates annotated bibliographies and other information on the use of microcomputers in education. Contact Susan Elting (703) 750-0500.

EPIE-Educational Products Information Exchange Institute
P.O. box 620
Stony Brook, N.Y. 11790
(516) 246-8664
This project evaluates educational software and microcomputers.

ERIC Clearinghouse on Handicapped and Gifted Children
CEC
1920 Association Drive
Reston, Virginia 22091
(703) 620-3660
This agency archives and, on request, produces copies of articles on technology in special education.

MICROSIFT-Microcomputer Software and Information for Teachers
Northwest Regional Educational Laboratory (NWREL)
500 Lindsay Building
300 S.W. 6th Ave.
Portland, Oregon 97204
(503) 248-6800
This project evaluates educational software and provides training to LEAs on the use of microcomputers.

APPENDIX B

Suppliers of Software Used in Special Education

NOTE: Inclusion in this list does not represent an endorsement of the products distributed by these vendors. Remember, as noted in the report, INSIST ON A REVIEW of all educational software before purchase.

The companies and agencies in this list are those that were identified by educators in the school districts that were visited, plus a few additional suppliers identified by Diane H. Shepard in her report "The one minute computer guide for special educators," available from Softswap, C.U.E., San Mateo County Office of Education, 333 Main St., Redwood California, 94063.

CIE Software News
Computer Information Exchange
Box 159
San Luis Rey, California 92068

EISI Computer Courseware
2225 Grant Road
Suite 3
Los Altos California 94022

Conduit
P.O. Box 388
Iowa City, Iowa 52244

Developmental Learning Materials (DLM)
1 DLM Park
Allen, Texas 75002

Hartley Courseware, Inc.
P.O. Box 431
Dimondale, Michigan 48821

Huntington Computing Catalog
P.O. Box 1297
1945 South Dairy
Corcoran, California 93212

Instant Software
Peterborough, New Hampshire 03458

K-12 Micro-media
172 Broadway
Woodcliff Lake, New Jersey 07675

Suppliers (continued):

Marck
280 Linden Avenue
Brandon, Connecticut 06405

MEAN-Microcomputer Education Applications Network
Education Turnkey Systems
256 North Washington St.
Falls Church, Virginia 22046

Microcomputer Educational Programs, Inc.
157 South Kalamazoo Mall
Kalamazoo, Michigan 49007

MECC-Minnesota Educational Computing Consortium
2520 Broadway Drive
Saint Paul, Minnesota 53113

Opportunities for Learning, Inc.
Department L-4
8950 Lurline Ave.
Chatsworth, California 91311

Queue
5 Chapel Hill Drive
Fairfield, Connecticut 06432

Scholastic Microcomputer Instructional Materials
904 Sylvan Ave.
Englewood Cliffs, New Jersey 07632

School & Home Courseware, Inc.
Department 720
1341 Bulldog Lane
Fresno, California 93710

Softswap
Computer-Using Educators (C.U.E.)
San Mateo County Office of Education
333 Main Street
Redwood City, California 94063

Southern Microsystems for Educators
P.O. Box 1981
Burlington, North Carolina 27215

Sysdata International, Inc.
7671 Old Central Ave., N.E.
Minneapolis, Minnesota 55432

Suppliers (continued):

Teaching Tools: Microcomputer Services
P.O. Box 50065
Palo Alto, California 94303

The Learning Company
4370 Alpine Road
Portola Valley, California 94025

Total Information Educational Systems (TIES)
Minnesota School Districts Data Processing Joint Board
1925 West County Road B-2
Saint Paul, Minnesota 55113